Armed Forces College of Medicine

AFCM

كلية الطب بالقوات المسلحة

Armed Forces College of Medicine

Neuroscience module

Clinical Integrated Cases
Session 3

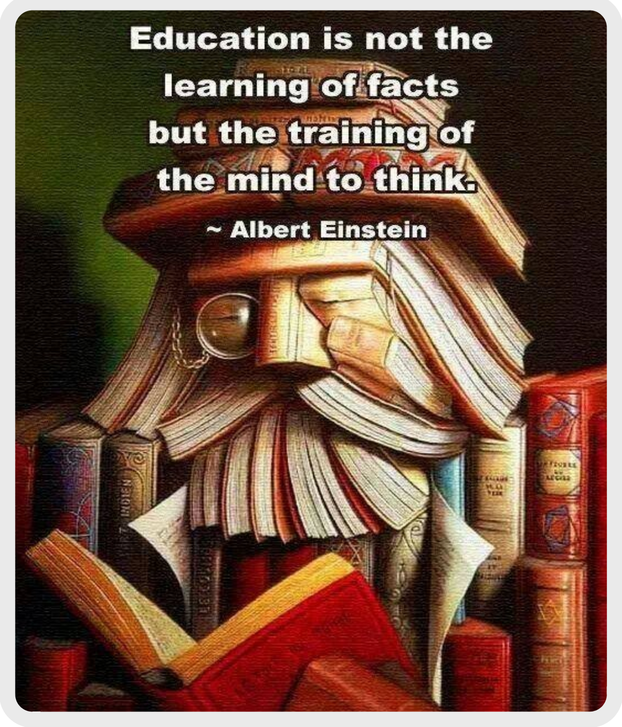
Basic Science Principles for Clinical Reasoning

1- **Critical thinking**

2- Introduction to common forms of disease

3- Apply basic knowledge in a realistic clinical scenario.

4- Interpersonal skills-(share and apply


Education is not the learning of facts but the training of the mind to think.
~ Albert Einstein

Case co-ordinators

Prof. Dr. Manal Hassan, Lamiaa Foad, Mohammad Edrees

safety

Sharing Departments

- **Neurology medicine**
- **Physiology**
- **Biochemistry**
- **Pharmacology**
- **Anatomy**
- **Histology**

Case: Swaying gait

Imbalance and swaying gate

Hoda is a **56**-year-old woman went to a neurologist for a variety of complaints, including an **irregular swaying gait to the right**.

Her family recently noticed that she had **difficulty in keeping her balance when standing still**, and she found that **standing with her feet apart** helped her keep her balance.

Hoda also complained of **difficulty with simple motor tasks, such as in eating, putting the spoon in her mouth, may spill off. buttoning a shirt because of tremors**

Imbalance and swaying gate

General examination

Vital signs:

Pulse: 60/min and regular,

Blood pressure: 134/84 mmHg.

Temp: 37ºC

There are no abnormalities in the cardiovascular or respiratory systems.

Imbalance and swaying gate

Neurological Examination

Mental state:

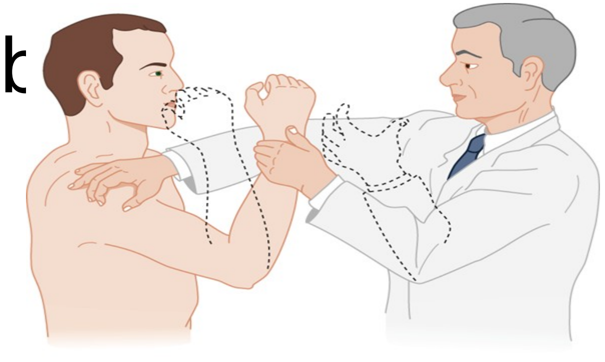
conscious, oriented co-operative of depressed mo

Motor:

- no muscle wasting and power is normal.
- **diminished tone and reflexes** of the muscles of her right upper and lower limbs
- **Finger to nose test** was positive on right side but normal on left side.
- **Heel to knee test** was positive on right side b normal on left side.

Rebound phenomenon was positive on right side

Dysdiadokokinesis on right side



Source: J. Biller, G. Gruener, P.W. Brazis: DeMyer's The Neurologic Examination: A Programmed Text, 7th Edition.
www.neurology.mhmedical.com
Copyright © McGraw-Hill Education. All rights reserved.

Imbalance and swaying gate

Sensory examination: normal
Cranial nerve examination: normal
Horizontal nystagmus on the right

Gait: wide-based gait
swaying to right side
Loss of tandem gait

Speech: normal speech

Cranium and spine examination: normal

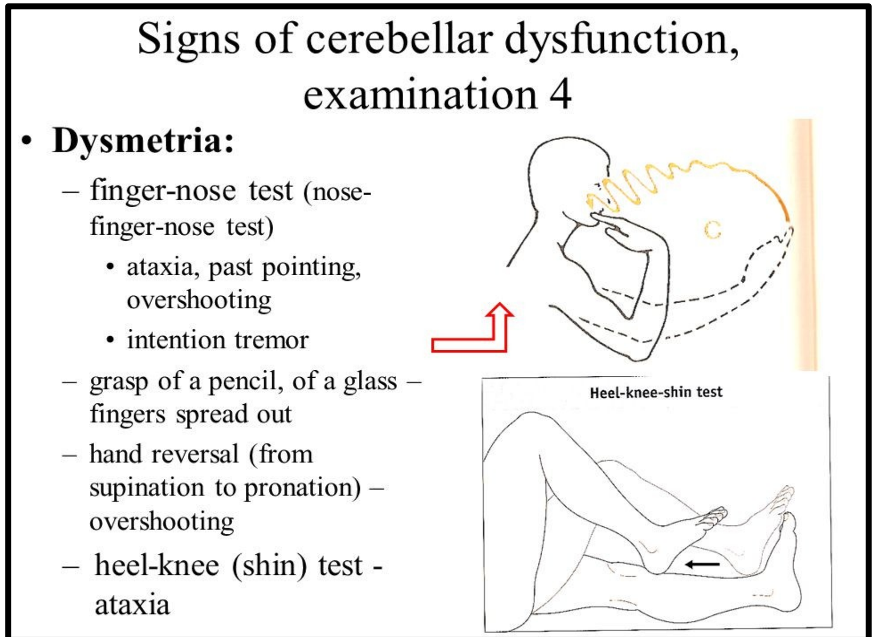
1- a-List the problems of Hoda

b- Where is the lesion?

- Balance defect: standing with legs apart
- Incoordination of movement in the form of kinetic tremors
- Hyporeflexia
- Gait disturbance (wide gait)
- Positive cerebellar tests

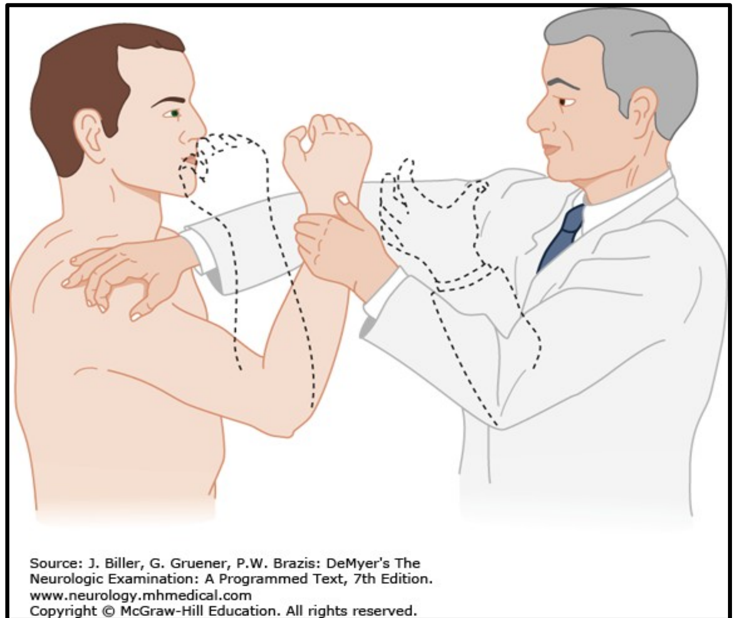
↓

Cerebellar ataxia


Signs of cerebellar dysfunction, examination 4

- **Dysmetria:**
  - finger-nose test (nose-finger-nose test)
    - ataxia, past pointing, overshooting
    - intention tremor
  - grasp of a pencil, of a glass – fingers spread out
  - hand reversal (from supination to pronation) – overshooting
  - heel-knee (shin) test - ataxia

Heel-knee-shin test


Source: J. Biller, G. Gruener, P.W. Brazis: DeMyer's The Neurologic Examination: A Programmed Text, 7th Edition.
www.neurology.mhmedical.com
Copyright © McGraw-Hill Education. All rights reserved.

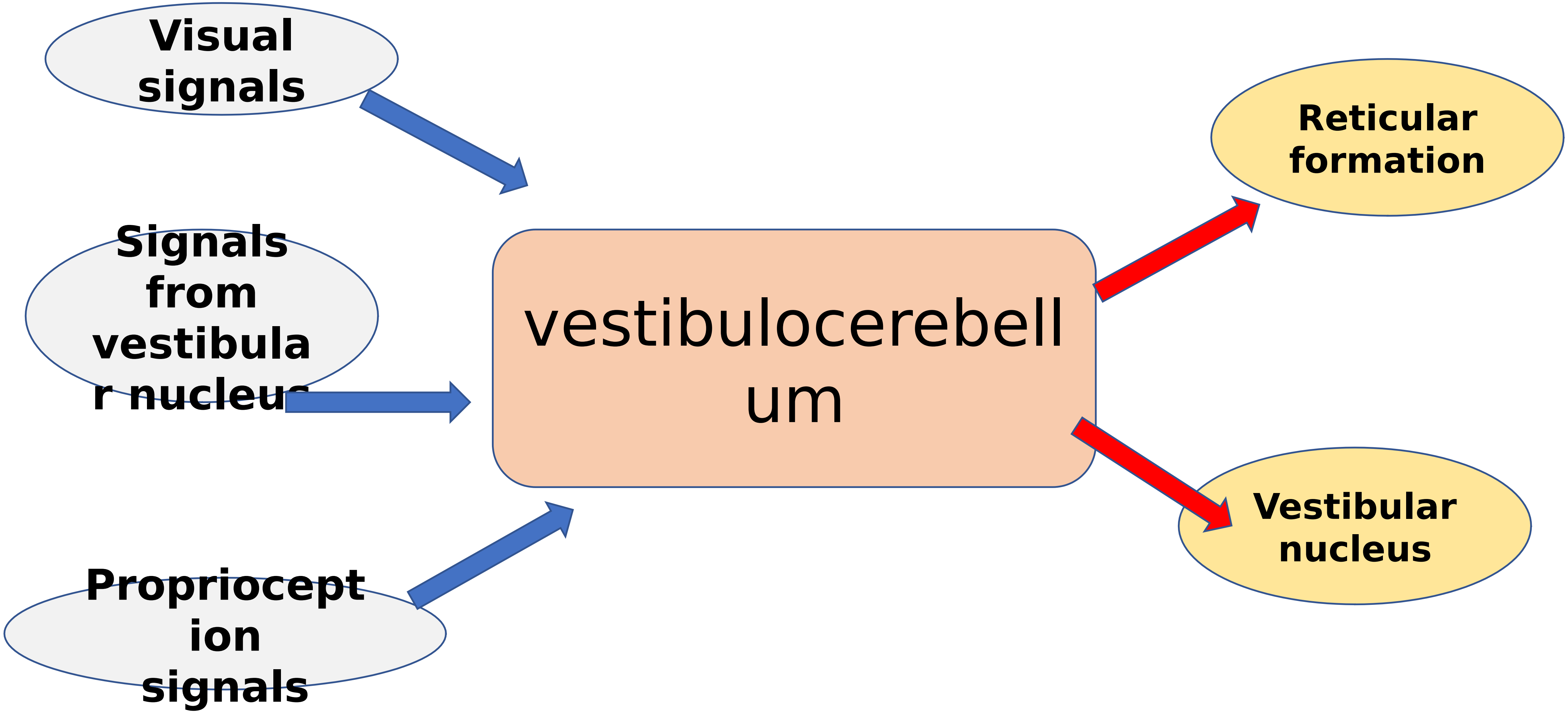
Hoda also complained of difficulty with fine motor tasks, such as eating, writing or buttoning a shirt because of tremors

2- What is the type of the tremors in Hoda?

Explain

- Intentional tremors.
- On reaching target.

3- Explain the wide based gait in Hoda?



Visual signals

Signals from vestibular nucleus

Proprioception signals

vestibulocerebellum

Reticular formation

Vestibular nucleus

Lesion in vestibulocerebellum leads to truncal ataxia

She has normal speech

Could the speech be affected in Hoda

Explain

- Speech wasn’t affected because cerebellar affection is unilateral and acute.
- Staccato speech usually caused by gradual diffuse affection of both cerebellar hemispheres as hereditary ataxias or disseminated inflammation as multiple sclerosis

4- Explain the physiological basis of speech affection in cerebellar lesions

–

- **Spinocerebellum coordinates the ongoing movement by;**
  - **servocomparator, damping function , turn on and off circuits**
- **Cerebrocerebellum is responsible for**
  - **Planning of voluntary movement {feed forward control before action is taken}**

a- Planning of sequential movements

Generation of the motor command of the next movement at the same time current movement is still executed.

- Movements progress smoothly and rapidly.

b- Timing of sequential movements

Provide proper timing for each movement

Lesion in spinocerebellum and cerebrocerebellum leads to lack of coordination and inability to perform rapid movements

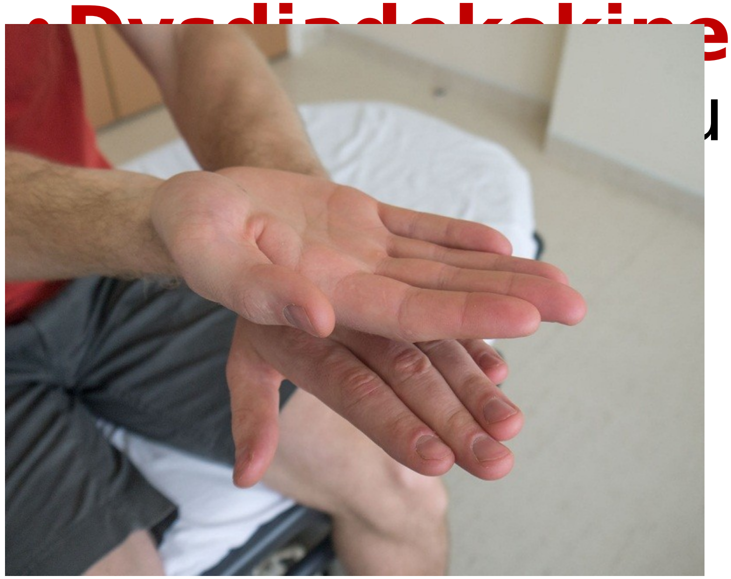
Rebound phenomenon was positive on right side

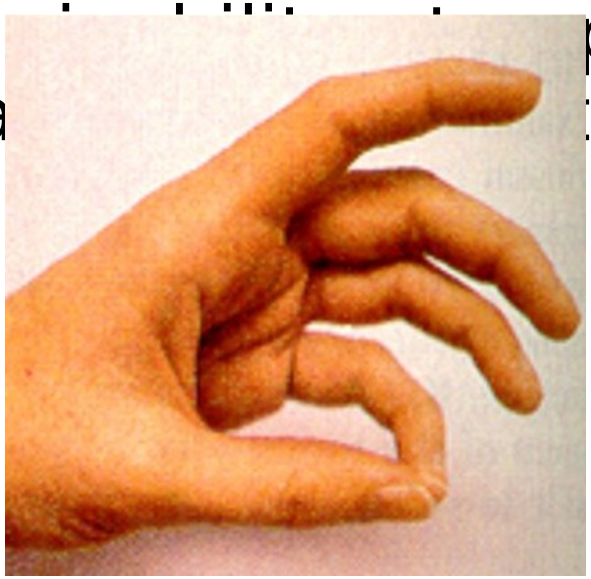
Dysdiadokokinesis on right side

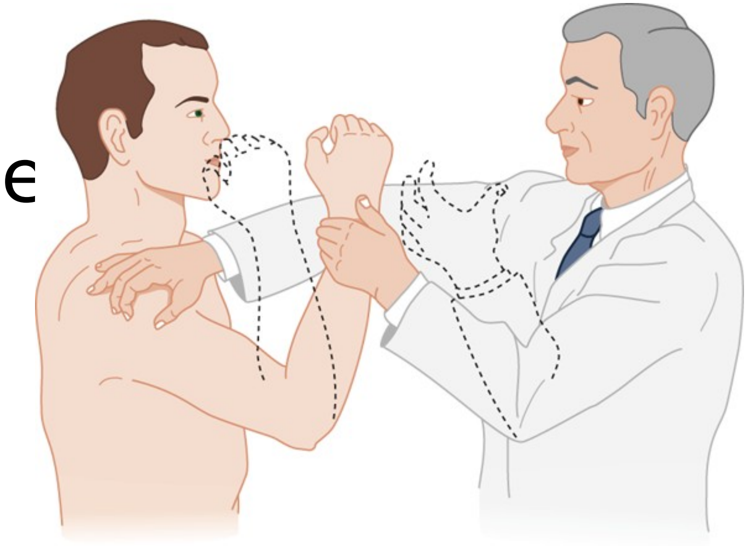
5- Explain these findings in Hoda

- Cerebellum control the **same side** of the body.
- Loss of damping function, dysmetria, overshooting and lack of coordination **due to lesion in spinocerebellum and cerebrocerebellum** lead to:

- **A positive rebound phenomenon** consists of inadequate braking of the normal, small rebound movement that occurs when the patient isometrically contracts a muscle against the examiner's resistance and the resistance is suddenly removed in the **Arm pulling test**.
- **Dysdiadokokinesia** perform
upina ion of the







Source: J. Biller, G. Gruener, P.W. Brazis: DeMyer's The Neurologic Examination: A Programmed Text, 7th Edition.
www.neurology.mhmedical.com
Copyright © McGraw-Hill Education. All rights reserved.

6- Classify the cerebellum anatomically and functionally?

Lobes of the Cerebellum

Anatomical Classification

1. Anterior lobe
2. Posterior lobe
3. Folluculonodular

Functional Classification

1. Archicerebellum
2. Paleocerebellum
3. Neocerebellum

Anatomical Lobes of the Cerebellum

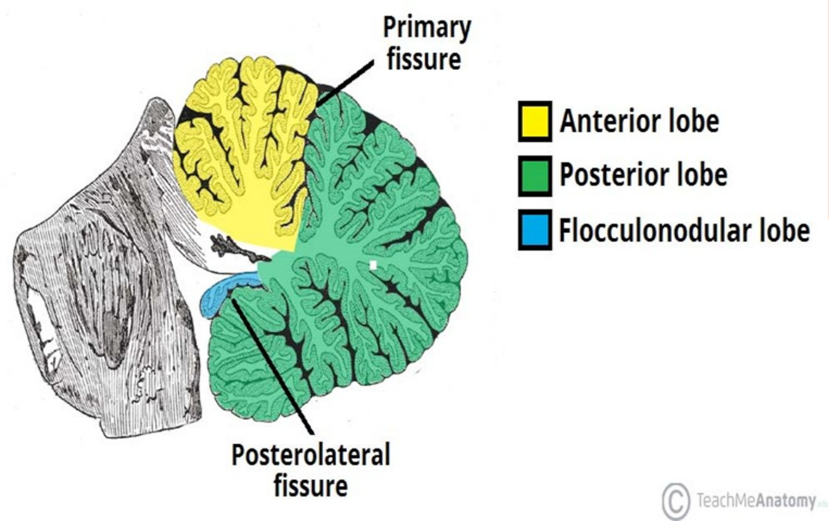
1. Anterior lobe: infront of the primary fissure.

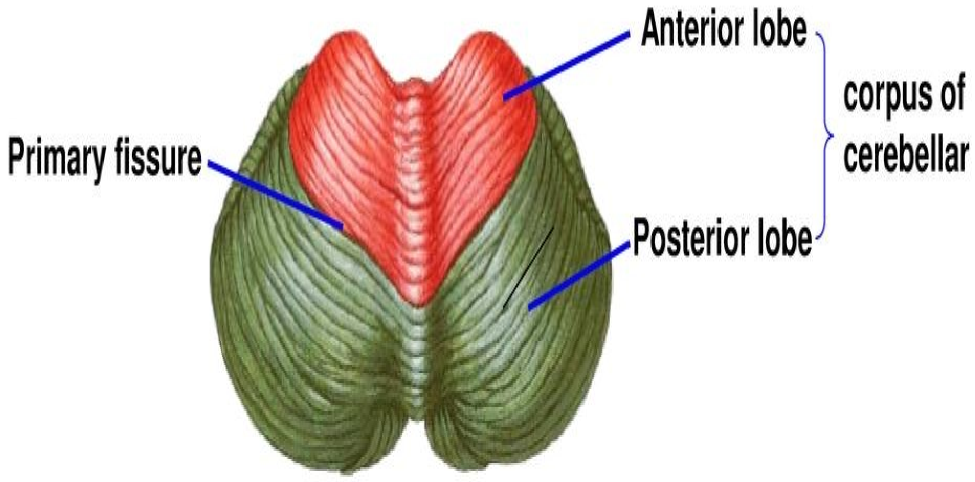
2. Posterior lobe: behind the primary fissure.

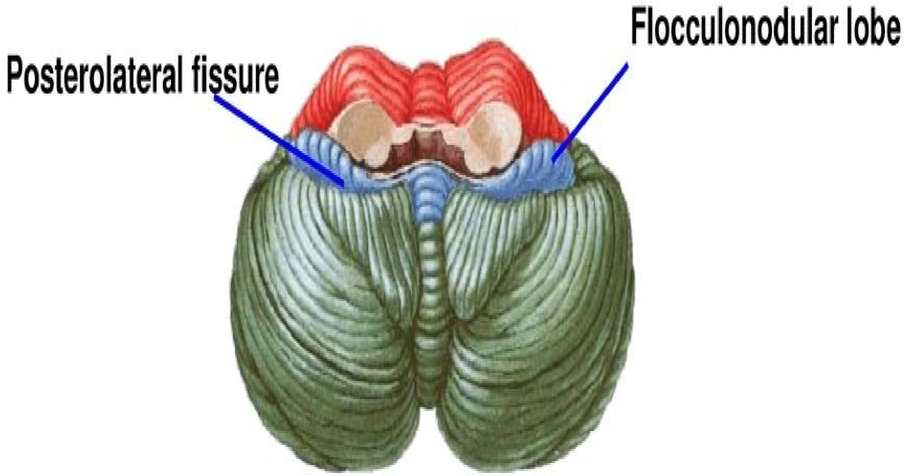
3. Flocculonodular lobe: separated

from

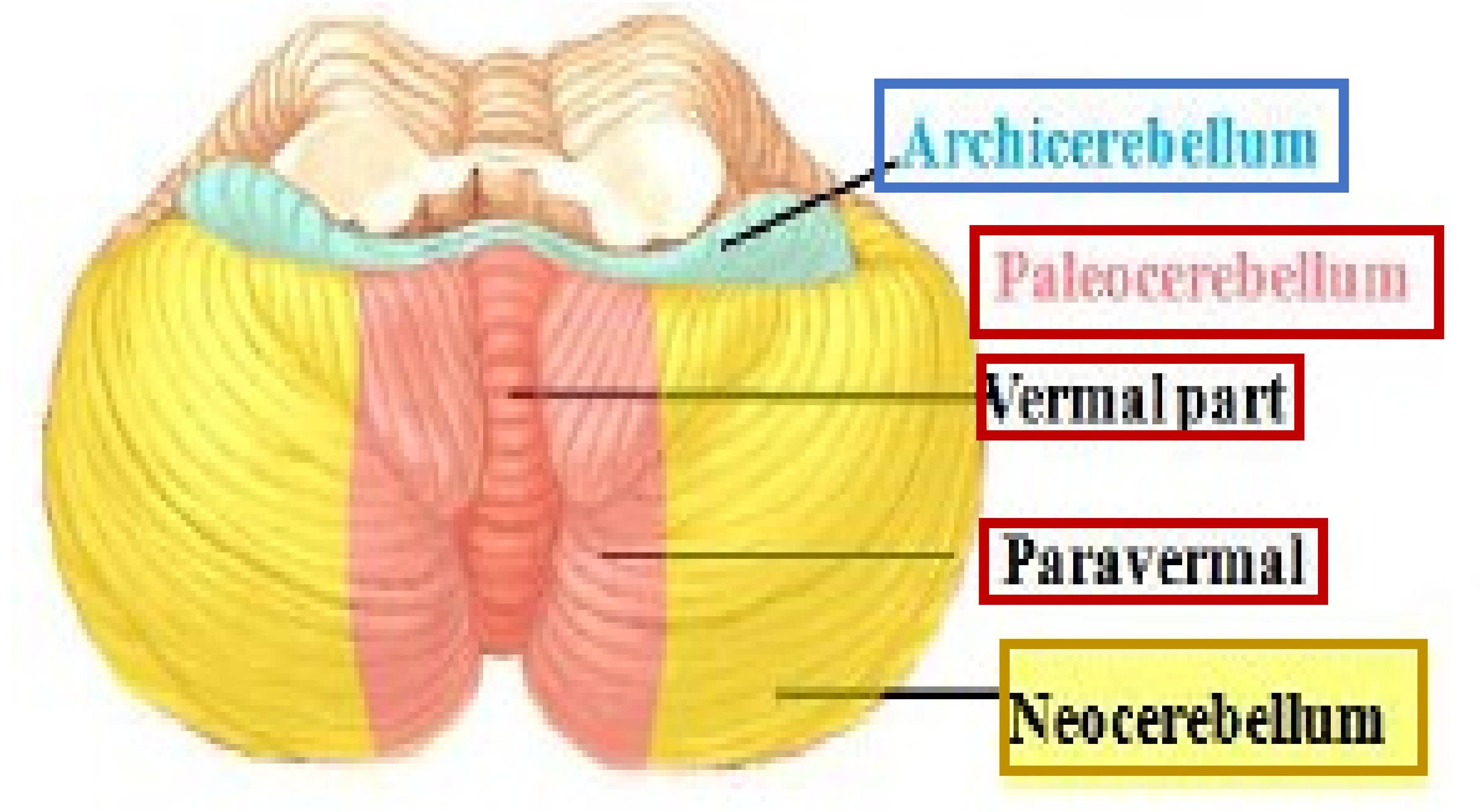
poste







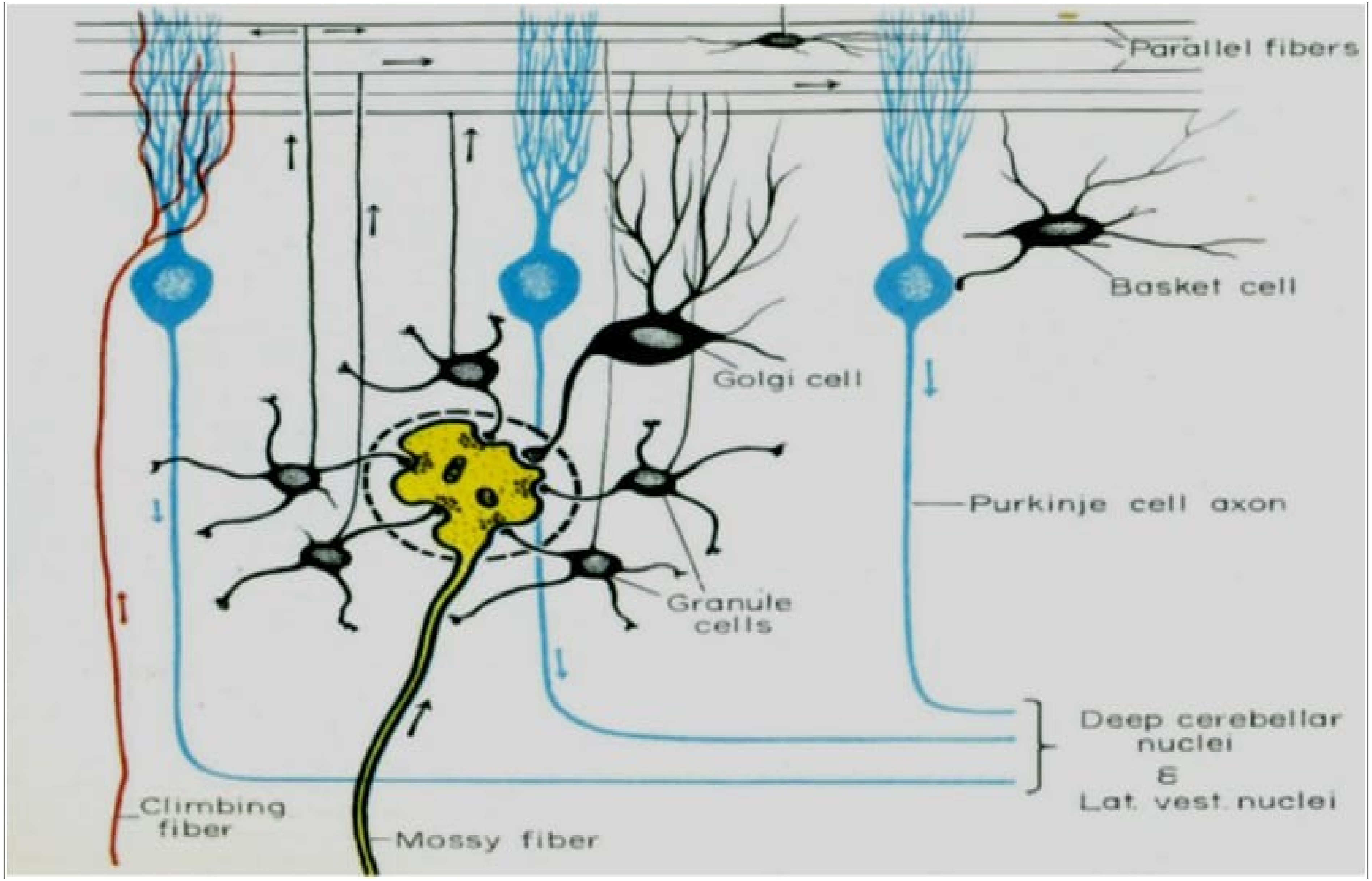
Functional Lobes of the Cerebellum



Circuits inside cerebellum ---- make coordination

7- What are the layers of the cerebellar cortex?

Mention the cells and fibers in each layer



Molecular layer

Purkinje cell layer

Granule cell layer

8- What are the cerebellar afferent fibers and how do they reach the cerebellum?

cerebellar afferents

vestibulocerebellu

Tecto-cerebellar tract (superior

Vestibulo-cerebellar tract (Inferior

Dorsal spino-cerebellar tract (Afference copy) (Inferior peduncle)

spinocerebellum

Cortico-ponto-cerebellar pathway(Middle peduncle)

Ventral spino-cerebellar tract (efference copy) (superior peduncle)

Dorsal spino-cerebellar tract (Afference copy) (Inferior peduncle)

cuneo-cerebellar tract (Inferior peduncle)

Olivo-cerebellar tract (Climbing fibers)

9- a- What is its neurotransmitter of the Purkinje cell?

b- How it is synthesized

GABA is an

inhibitory neurotransmitter

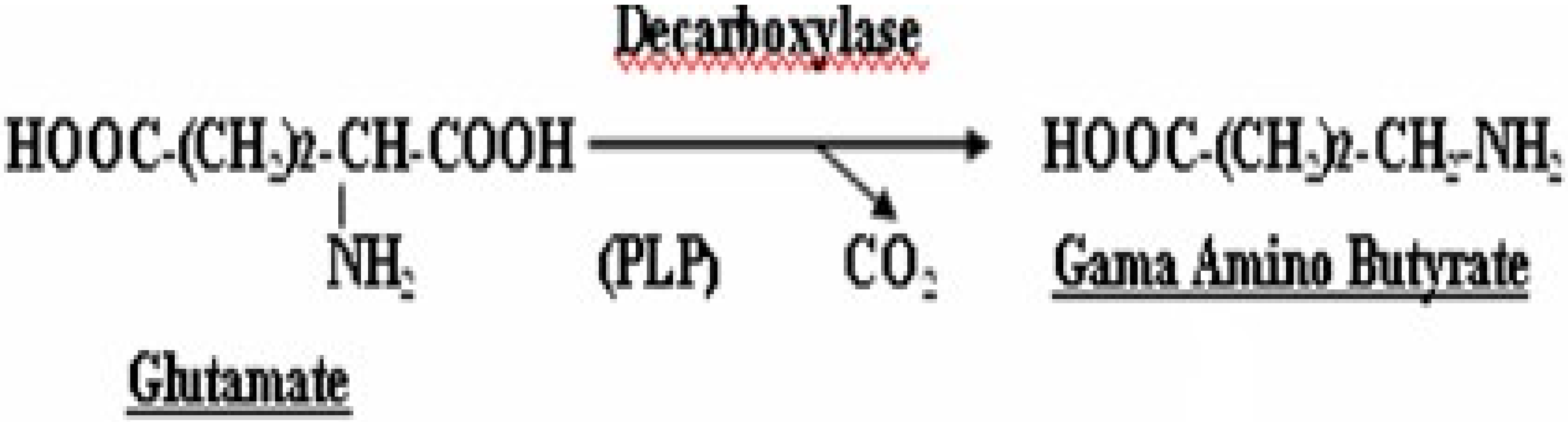
derived from glutamic acid

by

glutamic acid decarboxylase (GAD) enzyme

pyridoxal phosphate is required as a coenzyme

Synthesis of neurotransmitter (GABA)



$$\underset{\text{Glutamate}}{HOOC\text{-}(CH_2)_2\text{-}\underset{NH_2}{\underset{|}{CH}}\text{-}COOH} \xrightarrow[\text{(PLP)}]{\text{Decarboxylase}} \underset{\text{Gama Amino Butyrate}}{HOOC\text{-}(CH_2)_2\text{-}CH_2\text{-}NH_2} + CO_2$$

*** Its level is reduced in brain in Vitamin B6 deficiency with signs of hyperactivity and convulsions treated by Barbiturates (GABA AGONIST)**

Explain the hypotonia observed in Hoda using your information about cerebellar connections?

Cerebellum affect muscle tone

- **Cerebellar output:** to reticular formation, then reticulospinal and vestibular nucleus then to vestibulospinal tracts affect γ motor neurons and muscle tone.

Spinocerebellum inhibitory	Cerebrocerebellum excitatory
The predominant effect is facilitatory so cerebellar lesions lead to hypotonia	

- Cerebellar lesion leads to hypotonia and pendular knee jerk.
- Knee jerk is weak and during relaxation of the muscle the leg falls like a dead weight, sometime like a pendulum

Is the drug history important in this case?

- **Antiepileptics: Phenytoin**, Valproic acid Carbamazepine
- **Benzodiazepine**s
- **Lithium**
- Metronidazole in high doses

Mostly the drug induced ataxia is **reversible** **except** that induced by **chronic use of lithium, it is often permanent**

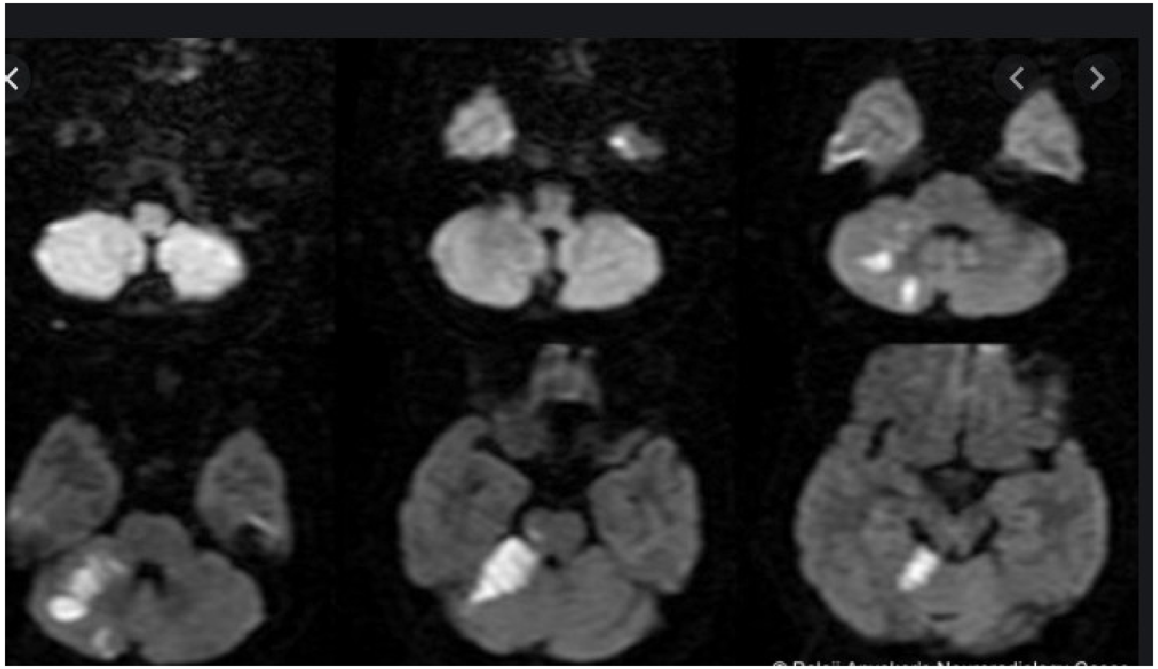
10- What are the investigations needed to prove your diagnosis?

MRI or CT Brain to exclude
Stroke
Tumor
Demyelinating disease
Tuberculoma
Toxic eg alcohol

Welcome Back

Imbalance and swaying gate

The doctor asked for **CT** brain and **MRI**



Diagnosis: Rt Cerebellar infarction

Imbalance and swaying gate

The doctor told her that she had an infarction and she was late. He prescribed her:

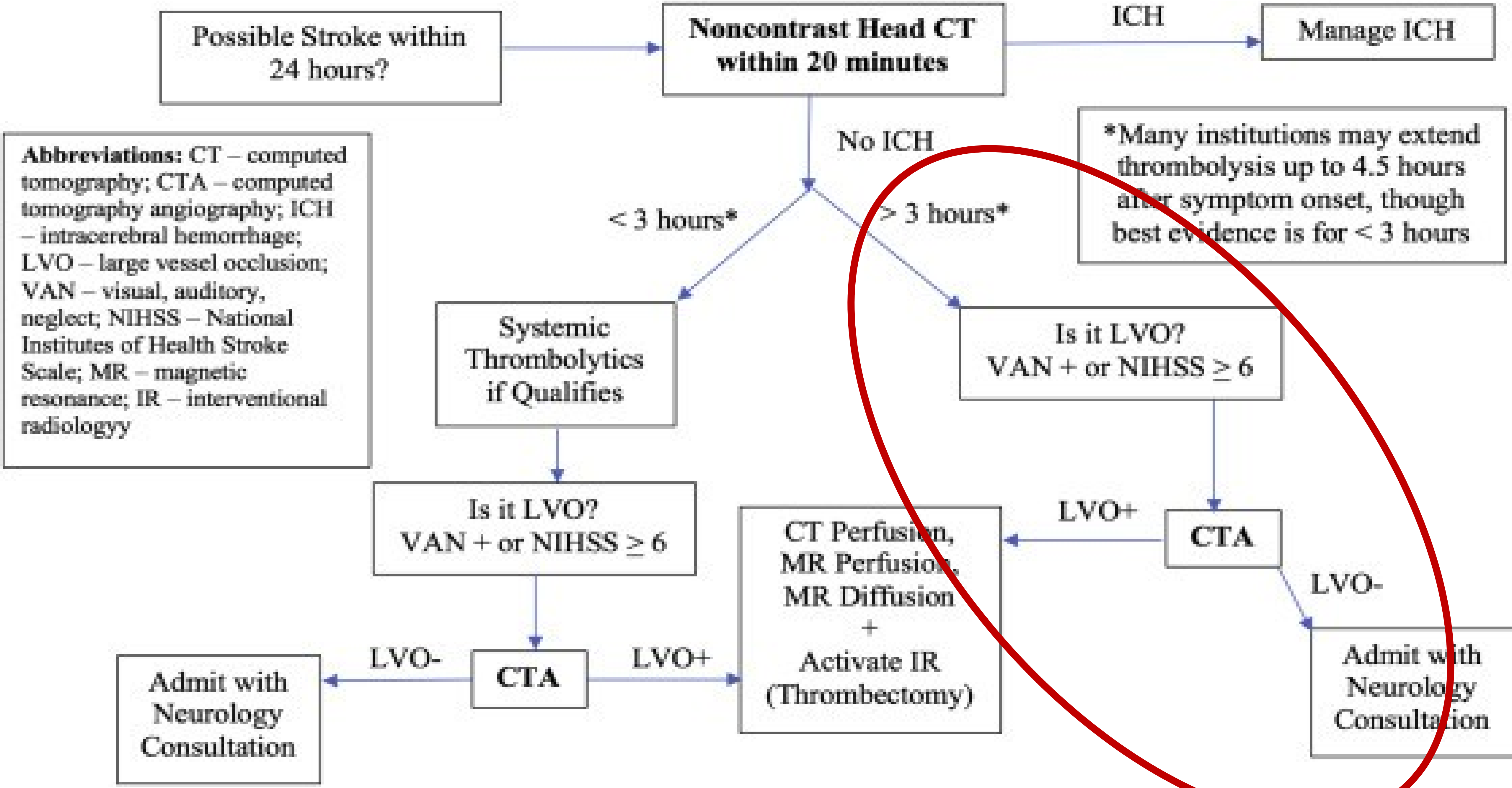
Aspirin and clopidogril for 21 days.

The doctor told Hoda that she will **continue on aspirin for life.**

He also asked her to do **physiotherapy** and certain investigations including lipid profile and echocardiography to assess the risk factors

Over the following 3 months on medical treatment and physiotherapy patient improved and could walk without support

11- What is the management of Hoda?



Possible Stroke within 24 hours?

Noncontrast Head CT within 20 minutes

ICH

Manage ICH

No ICH

< 3 hours*

> 3 hours*

*Many institutions may extend thrombolysis up to 4.5 hours after symptom onset, though best evidence is for < 3 hours

Abbreviations: CT – computed tomography; CTA – computed tomography angiography; ICH – intracerebral hemorrhage; LVO – large vessel occlusion; VAN – visual, auditory, neglect; NIHSS – National Institutes of Health Stroke Scale; MR – magnetic resonance; IR – interventional radiologyy

Systemic Thrombolytics if Qualifies

Is it LVO?
VAN + or NIHSS ≥ 6

CTA

LVO-

Admit with Neurology Consultation

LVO+

CT Perfusion,
MR Perfusion,
MR Diffusion
+
Activate IR (Thrombectomy)

Is it LVO?
VAN + or NIHSS ≥ 6

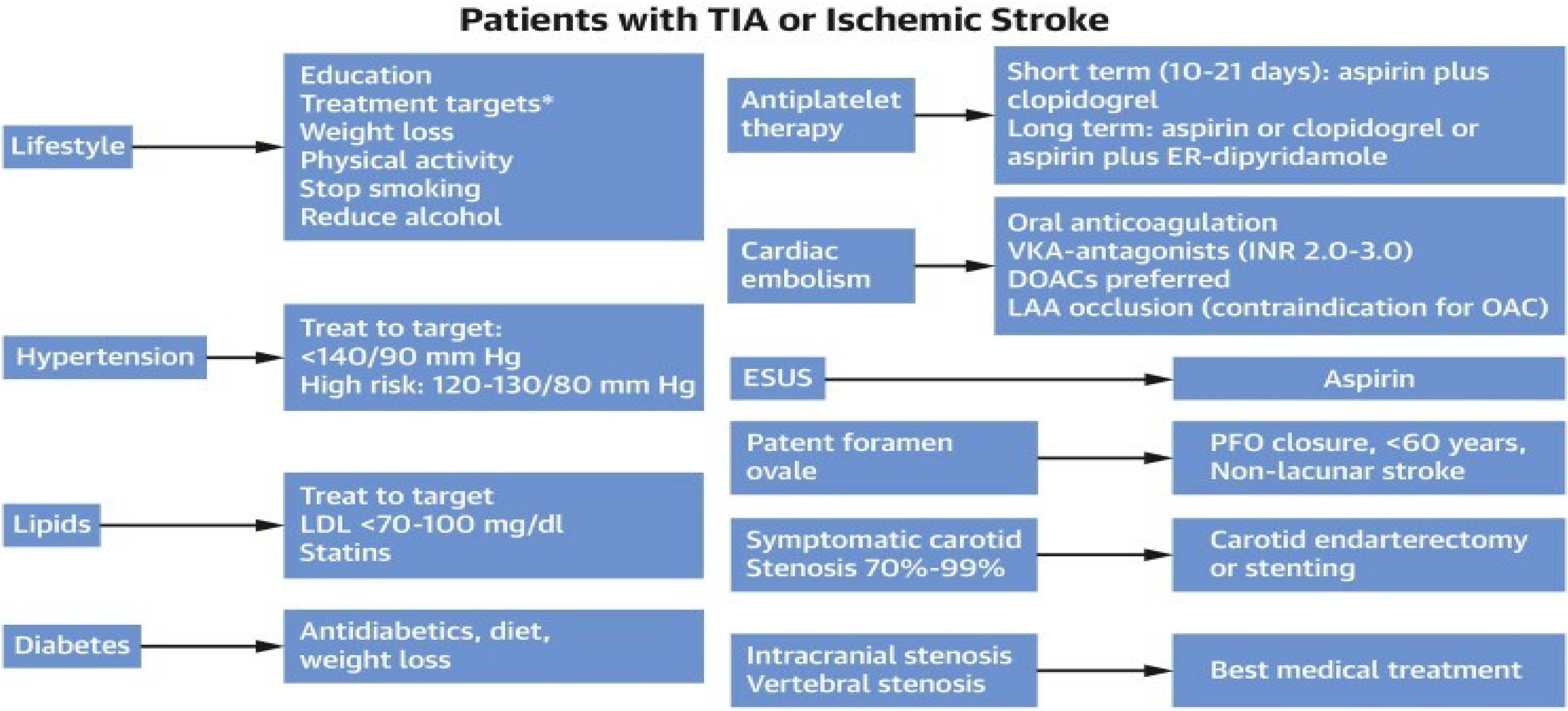
CTA

LVO+

LVO-

Admit with Neurology Consultation

CENTRAL ILLUSTRATION: Treatment Options for Secondary Prevention After a Transient Ischemic Attack or Ischemic Stroke



Patients with TIA or Ischemic Stroke

Lifestyle	Education Treatment targets* Weight loss Physical activity Stop smoking Reduce alcohol
Hypertension	Treat to target: <140/90 mm Hg High risk: 120-130/80 mm Hg
Lipids	Treat to target LDL <70-100 mg/dl Statins
Diabetes	Antidiabetics, diet, weight loss
Antiplatelet therapy	Short term (10-21 days): aspirin plus clopidogrel Long term: aspirin or clopidogrel or aspirin plus ER-dipyridamole
Cardiac embolism	Oral anticoagulation VKA-antagonists (INR 2.0-3.0) DOACs preferred LAA occlusion (contraindication for OAC)
ESUS	Aspirin
Patent foramen ovale	PFO closure, <60 years, Non-lacunar stroke
Symptomatic carotid Stenosis 70%-99%	Carotid endarterectomy or stenting
Intracranial stenosis Vertebral stenosis	Best medical treatment

Diener, H.-C. et al. J Am Coll Cardiol. 2020;75(15):1804–18.

Take Home Messages

- Ataxia is either hereditary or acquired.
- Ataxia may be due to cerebellar lesion or lesion in cerebellar connections, mostly in brain stem.
- Pathology depends on onset course and duration.

Thank you